

Forecasting

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Forecasting: Principles and Practice

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- New open standards created in the mobile era, such as HTML5, will win on mobile devices (and PCs too). Perhaps Adobe should focus more on creating great HTML5 tools for the future, and less on criticizing Apple for leaving the past behind. (Steve Jobs about Flash in 2010)

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Applications

- Whether to build a power plant in the next five years based on forecast of future demand
- Stocking an inventory based on forecast of stock requirements

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- how much data is available;
- whether the forecasts can affect the thing we are trying to forecast.

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- the fact that we can forecast electricity demand does not seem to affect the forecast

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For stock price prediction:

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- there is a lot of past data available
- the fact that we can forecast stock prices will lead to change in market dynamics and it will affect the forecast

Example of Forecasting

Forecast of production of beer in Australia

Dark blue lines show the mean forecast

Light blue band shows the confidence interval

Three Types of Forecasting Models

Task: Forecast Electricity Demand at Time T

1. Explanatory model

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2. Timeseries model

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3. Mixed model

$$E_T = f(E_{T-1}, E_{T-2}, \text{Temperature}_T, \text{GDP}_T, \text{Population}_T, \dots)$$

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- A large increase in passenger load occurred in the second half of 1991.
- There are some large dips in load around the start of each year. These are due to holiday effects.

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- **Cyclic:** A cycle occurs when the data exhibit rises and falls that are not of a fixed frequency.

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Seasonal v/s Cyclic

- Seasonality: within every year, there is pattern of sales
- Cyclic: Every 6 years or so, there is a similar pattern

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 - Let us assume we are forecasting monthly and we want to forecast for Mar 2020 (month=3) and current time is Jan 2020 (month=1). Thus, $h = 2$. Let us assume yearly seasonality, i.e. $m = 12$. Thus, prediction for Mar 2020 is value at (Jan+2 months) - $12 \times 2 - 1\%12 = \text{Mar 2020} - 12 \text{ Months} = \text{Mar 2019}$

Learning: Simple solutions often work well, especially if you know about the domain.

Evaluating Forecast Accuracy

Timeseries cross-validation for 1 timestep ahead prediction

Question: How do you nested CV?

Answer: Similarly divide the train into train and validation preserving the notion of timeseries.

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Timeseries cross-validation for $k = 4$ timestep ahead prediction

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- Time series with trends, or with seasonality, are not stationary
- White noise series is stationary — it does not matter when you observe it, it should look much the same at any point in time.

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- Series with trends: a, c, e, f, i
- Series with seasonality: d, h, i
- Stationary: b and g (cycles are aperiodic)

What is the relation between a and b ?
 b is the first order time difference of a !
 b is stationary, while a is not!

For (a) the ACF is significant

For (b), the ACF declines rapidly

$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \cdots + \phi_p y_{t-p} + \varepsilon_t$, where ε_t
is white noise.